

WASHINGTON

SCIENCE TRENDS

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SUPERSONIC TRANSPORTS

Should the U. S. Government support development of a supersonic transport? Most Federal authorities in the field believe so. Here is a summary of some of the problems involved as outlined by Ira H. Abbott, Director of Advanced Programs, National Aeronautics and Space Administration:

*Economics: "The step from the supersonic bomber to the transport is greater than has previously been the case, development costs will be much higher, and the large carrying capacity of such airplanes may well result in a smaller production for the airframe industry."

*Technical Problems in comparison with those of the supersonic bomber include:

Larger fuselage volume to accommodate the passengers.

Longer operating life of many thousands of hours to be economical.

Compatibility must be assured, both with airports and with the traffic control system that can be brought into operation at the time the airplane goes into service. This requires careful engineering for piloting, navigation and control.

Undue noise at or in the vicinity of the airport or over the routes that it will be flown will be a problem. Much can be done with development of a new turbofan engine. Sonic boom is an even more serious problem which may require design compromise. One solution may be increase of the wing span at low speeds which appears to offer promise of large performance gains during climb, landing and takeoff -- without introducing excessive complications and weight.

Safety requirements will also be more stringent than for the bomber, and more difficult to realize.

*Growth Potential: This is also an important consideration. Such a project should be planned so as to avoid later developmental costs to achieve increased performance and to avoid the difficulties of bringing another completely new airplane into operation.

*Structural Materials also pose difficulties. Stainless steel or titanium might be required because of high temperatures at speeds of 2,000 miles per hour. Fabrication of these materials for aircraft, however, is expensive and much more research is required. Reducing speed to 1,300 miles per hour would permit consideration of aluminum alloys but would raise new problems of metal fatigue.

"Technical Feasibility," The NASA official reports is nevertheless established "in the sense that we can predict with confidence that a concerted and vigorous research and development program can lead to satisfactory solutions."

Digital Television Transmission

Studies at the National Bureau of Standards, Boulder, Colo. have led to the conclusion that a digital system offers many advantages for television transmission. The proposed system is receiving primary attention in military devices which are not subject to Government broadcast standards regulation. Attention is also being given to digital techniques for a more reliable color tv system, and for improved frequency bandwidth conservation.

Background: The digital television system concept has arisen as a part of the search for means of reducing bandwidth requirements and noise disturbances in available systems. It was believed that advances in the fields of information and communication theory since the adoption of television standards in 1946 made it feasible to consider alternate methods of transmission.

Human Capability: Theory indicates, according to the NBS study, that an ideal transmission system for television is capable of transmitting approximately 54 million bits of information per second. The TV watcher, on the other hand, is believed to be capable of perceiving no more than 50 bits per second. Even in a "practical" working system, it is believed, there is still a disparity of many hundreds of thousands of times.

Information Correlation: This disparity leads to the proposal that, instead of seeking encoding methods that faithfully retain all the information in a picture mosaic well beyond human capability to receive, attempts be made to send information according to apparent time patterns of this capability. One way to do this is by choosing a system of modulation in which only changes information will be sent.

Modulation System Experiments: The key to this system is the "stretchout" of information in which the data function becomes one of time as well as amplitude. In experiments, side-by-side comparison of analog and digital system monitors have been made using a wide range of still and rapidly moving camera subjects. No perceivable reduction of information in the difference signal digitizing process could be found.

Other Advantages: The NBS study indicates that conversion to a binary television system would bring a number of advantages. Since the receiver detector is only required to detect the presence or absence of a signal, the tv signal has a noise penetration benefit comparable to that of telegraphic transmission versus voice. Being in digital form, the signal can be scrambled and unscrambled easily for military security. The signal can be regenerated at a receiving point and can therefore be reinstated over a large number of communications links and repeater stations in tandem, without extra noise through repeated amplification. Most important of all, according to the study, would be the many possibilities for transmission flexibility and bandwidth conservation.

Recommendations: The study calls for a complete review of the whole concept of television transmission as now practiced. An immediate need, it is reported, is further study and evaluation of human perception abilities and mechanisms. Another is a complete investigation of digital transmission aspects.

(Study by William C. Coombs, Chief, Systems Analysis Section, Radio Communications and Systems Division, National Bureau of Standards, Boulder, Colo. Report dated 1959, now available. 26 Pages. 50 cents. Write OTS, U. S. Department of Commerce, Washington 25, D. C. for NBS Technical Note No. 25 -- Communication Theory Aspects of Television Bandwidth Conservation)

R & D TRENDS

- * Submarine Battle Simulator: Tiny models in a mock sea will be used by the Navy for simulated Naval battles at its submarine school, New London, Conn. The facility will consist of four major parts--the attack centers of three nuclear submarines, targets, instructor's consoles and a digital computer. Radar and sonar in the attack centers will show the complex movements of many ships in a sea encounter; periscopes will show targets exactly as they would be seen from the periscope of a submerged submarine. Targets will be automatically positioned so as to present the correct aspect to the telescope, as viewed through closed circuit television. Targets will also sink below the horizon, in proportion to the simulated distance from the periscope.

Information will be correlated and processed on a large scale digital data processing system. In addition to generating the motion of an ocean full of various ships, the machine will also calculate the action of various weapons--such as the search and attack of a torpedo homing onto its target. The Navy expects that this will eliminate the necessity for developing new training devices and facilities when weapon systems change.

(Development and Construction to be performed by Ordnance Division, Minneapolis Honeywell Regulator Co., Hopkins, Minnesota)

- * Zero Gradient Proton Synchrotron: One of the most difficult fabrication operations ever undertaken in the nuclear energy field will be attempted in assembly of a 5,000-ton ring of eight steel magnets for the Zero Gradient Proton Synchrotron at Argonne National Laboratory, Argonne, Ill. The \$29 million machine will accelerate particles to energies of 12.5 billion electron volts for studies of the basic nature of matter. The magnets are composed of 40 thousand half-inch tapered steel sheets glued and bolted together. Each of the eight magnets will have a hollow rectangular "window frame" center to form a passage whose top and bottom vary only a few thousands of an inch from an absolutely horizontal plane. The ZGS is projected for completion in 1962.

- * Undergraduate Research Programs: The National Science Foundation is making available \$1.8 million in grants this year for undergraduate participation in research programs and projects of colleges, universities and non-profit research organizations. Some 2,500 students will work in the physical, biological and social sciences, mathematics and engineering. They will receive a stipend of up to \$60 per week for eight to ten weeks of full time summer work, or an average stipend of \$150 for academic work on a part time basis.

(For details of these programs write Information Office, National Science Foundation, Washington 25, D. C. for NSF Release 60-123. A list of institutions participating, with names of program directors and dates is also available.)

- * Evaporation Reduction Research: Bureau of Reclamation, U. S. Department of the Interior, has contracted with Montana State College for fundamental research on the behavior of a monolayer --a covering one molecule thick--placed upon water surfaces for the purpose of reducing evaporation loss. The studies are part of a program for conservation of water supplies, particularly in Western States. Alcohols are used in which molecules align themselves so that one end is always in the water and the remainder extends out of the water. The suppressing effect on evaporation takes place when the monolayers on the water surface are in a compressed state.

* Transferring Liquified Gases:

Studies by the National Bureau of Standards, based on mathematical models, indicate that it will be feasible to transport liquified gases by pipeline over considerable distances. In many cases, the Bureau states, such a system could undoubtedly increase efficiency, safety and economy when compared with conventional transportation in insulated, Dewar-type containers.

Potential losses which might occur during long-distance transfers were studied in determining the economic and feasibility aspects of such a system. The Bureau set up a system by which any type of loss can be computed. This includes loss at the pump due to energy dissipation in the pump container and cooling prior to line entry; flashing loss caused by heat leak and energy introduced by a preceding pump; cool-down loss which occurs when the system is cooled from ambient to operating temperature; and trapped-liquid loss from liquid that cannot be removed at the end of the transfer.

(Studies conducted by R. B. Jacobs, Cryogenic Engineering Laboratory, National Bureau of Standards, Boulder, Colorado)

* Electronic Equipment Cooling

Jet Propulsion Laboratory, California Institute of Technology, is studying the possible use of a fluid heat sink for the cooling of electronic equipment for space operations. Tests have been made with a water-saturated porous material pad attached to a simulated heat dissipation surface. In evaporative cooling it was found that only a fraction of the total water weight carried in such a pad would be useful. In vacuum evaporation tests water utilization factors dropped to less than 50 percent. Other materials and designs are now being investigated in order to utilize fully the weight of the heat sink and to evaporate all of the water absorbed in the porous pad. Among these are Chrysler Corp. Oilite bearing material, wire-wound filter elements of Poroloy from Bendix Aviation Corp., woven-wire cloth and a relatively new type of fine wire felt developed by the Armour Research Foundation.

* Oceanographic Research Tower

Detailed studies of the physical, biological, chemical and geological features of the sea are being conducted by the Navy with the aid of an unusual oceanographic tower constructed off Mission Beach, Calif. Advantages of this type of fixed installation are said to include stability, economy and a low self-noise level.

Specific instruments or groups of instruments are installed or removed from the tower as required. One study already undertaken involves the nature of internal waves. The Navy believes that one oceanographic feature which influences the transmission of sound in the sea, and thus detection, is the temperature structure, which is known to fluctuate vertically with respect to both time and distance. To measure these variations an isotherm or thermocline follower has been developed. This instrument is capable of seeking out a given temperature or isotherm and recording its variation in depth/time.

To use the instrument three booms are extended out from three corners of the tower with cables and sensing elements. All three elements are set to "lock on" to a set temperature in the thermocline and to stay with it as it moves up and down with internal waves. The depth of the thermocline in three locations is continuously recorded in the instrument house. The internal waves are progressive in nature and their speed, direction and amplitude can easily be obtained by minimal data processing.

RESEARCH CHECKLIST

- () Biological Transducers: Studies for the U. S. Air Force at the Yale University School of Medicine are aimed at more effective use of rapid transport and automatic control systems through the study of information-receiving systems in birds and animals. Typical are the ability of the hawk to "lock-in" on prey, the night vision of an owl, the ability of birds to migrate by the stars and the use of ultraviolet light by honey-bees to distinguish flowers. In one phase of this study a crayfish was used to determine how a simple biological transducer converts electromagnetic radiation energy to pulse-rate-modulated nerve impulse signals.

(Report Available. 29 Pages. 75 Cents. Write OTS, U. S. Department of Commerce, Washington 25, D. C. for PB 161 131)

- () Plastic Ducting: The Navy is experimenting with the use of pipes and ducts of high-impact type rigid vinyl chloride. Moldings of glass fiber reinforced polyester were tried and found unsuitable. The vinyl chloride is said to offer such advantages as corrosion resistance -- particularly near battery systems, nonmagnetic properties of value in minesweepers, less noise transmission than metal ducting and less weight. Cost is estimated to be 40 to 60 percent greater than comparable aluminum ducting but installations are being approved where the unique characteristics of plastics may be necessary.

(R&D reported by Bureau of Ships, U. S. Navy, Washington 25, D. C.)

- () Airborne Tellurometer: The Army is field-testing an airborne tellurometer expected to provide a position determination or a distance measurement up to 150 miles with a high degree of accuracy. This compares with the 40 mile range of ground tellurometers, which are also restricted to line-of-sight operation. In preliminary testing it was found that remote station siting and aircraft flight path must be carefully planned to eliminate unwanted ground reflected ray paths. Heavy rain and dense fog make measurements difficult and there is a possibility of enemy jamming of, and homing on, the equipment. However, it is expected that the final equipment will be modified to minimize these difficulties.

(Equipment developed by Tellurometer Ltd., Cape Town, South Africa. Studies reported by U. S. Army Engineer Research and Development Laboratories, Ft. Belvoir, Va.)

- () High Capacity Compressor: A design study for the Army by the University of Oklahoma Research Institute indicates the feasibility of a vane-type oscillating compressor for use where weight is a major consideration. The unit studied is designed for low-pressure requirements and weighs less than 45 pounds. Sealing ring material is strip Teflon with interlocking corners. The driving mechanism is steel and all bearings are sealed. Comparisons with other types of compressors are said to show a number of advantages.

(Report of Feb. 1959 now available. 140 Pages. \$3. Write OTS, U. S. Department of Commerce, Washington 25, D. C. for PB 161 347)

- () High-Purity Yttrium: Studies by the U. S. Bureau of Mines indicate that high-purity Yttrium is ductile enough to be worked into a promising structural metal with potential uses in atomic reactors and missiles. In experiments, yttrium trichloride was reduced to an extremely pure state by reacting it with hot lithium or sodium metal in a crucible filled with inert gas.

PUBLICATION CHECKLIST

- () The Sun, another in a new series of Reports in Progress prepared by the Space Science Board. This report, by Dr. Leo Goldberg, Chairman of the Department of Astronomy at the University of Michigan, summarizes present knowledge, reviews unsolved problems and suggests space experiments. 24 pages. \$1 (Write Printing and Publishing Office, National Academy of Sciences, 2101 Constitution Avenue, N. W., Washington 25, D. C. for Science in Space, Chapter VI)
- () Selected Semiconductor Circuits, a new Navy Handbook designed to provide the transistor circuit engineer with a reference of reliable, well-designed examples of contemporary circuits. Covers direct-coupled amplifiers, low-frequency amplifiers, high frequency amplifiers, oscillators, switching circuits, logic circuits and similar material. 458 Pages. \$2.75 (Write Superintendent of Documents, Government Printing Office, Washington 25, D. C. for Pub. No. D 211.6/2:C49)
- () Aerial Surveys, a review of the history, principles and procedures relating to aerial surveys in the field of highway engineering. 48 Pages. 40 cents. (Write Superintendent of Documents, Government Printing Office, Washington 25, D. C. for Pub. No. C 37.2:Ae 8)
- () Acoustic Sources, a bibliography prepared by Willow Run Laboratories for the Navy on published literature from 1935 through 1958. Covers single sources and receivers, arrays of sources and receivers, transducer properties and acoustic fields. Dated 1959 and now available. 68 Pages. \$1.75. (Write OTS, U. S. Department of Commerce, Washington 25, D. C. for PB 161 330)
- () Lubricating Oils -- Aviation Gas Turbines, a translation for the U. S. Government of a comprehensive Soviet report covering composition, operating requirements, testing and related information. 82 Pages. Single Copies Free. (Write National Aeronautics and Space Administration, 1520 H Street, N. W., Washington 25, D. C. ATTN: CODE BID for NASA TT F-21)
- () AEC Authorizing Legislation, a transcript of statements, testimony and exhibits presented to Congress in relation to the Fiscal 1961 program of the Atomic Energy Commission. Valuable reference to anyone in this field. 492 Pages. Single Copies Free. (Write Joint Committee on Atomic Energy, F-88, The Capitol, Washington 25, D. C. for Hearings, AEC Authorizing Legislation, F.Y. 1961)
- () Catalytic Cracking, a report on a Government study of the recycle hydrogenation of gas-combustion shale oil as a means of preparing a 700° F. end-point catalytic cracking stock. The yields and properties of gasoline obtainable through this process are also considered. 17 Pages. Single Copies Free. (Write Publications-Distribution Section, U. S. Bureau of Mines, 4800 Forbes Avenue, Pittsburgh 13, Pa. for Report of Investigation No. 5574)
- () Aircraft Engine Industry, a new Census Bureau report covering 1958 which shows that in a four-year period the value of products shipped increased five percent while employment was down eleven percent. 3 Pages. 10 Cents. (Available at Field Offices, U. S. Department of Commerce or write Publications Office, Bureau of the Census, Washington 25, D. C. for Pub. MC (P) -37B-2)
- () R&D -- Colleges and Universities, a report for Fiscal 1958 showing the impressive growth of research and development in institutions of higher education. Facts and figures on many aspects of this program. 7 Pages. Single Copies Free. Write Information Office, National Science Foundation, Washington 25, D. C. for Pub. NSF-60-21)

